UNION SWITCH & SIGNAL

A member of the ANSALDO Group
5800 Corporate Drive Pittsburgh, PA 15237

SERVICE MANUAL 6236

Installation, Operation and Maintenance

TRU-II AC TRACK UNIT

100 Hz and 91.67/100 Hz

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ANSALDO
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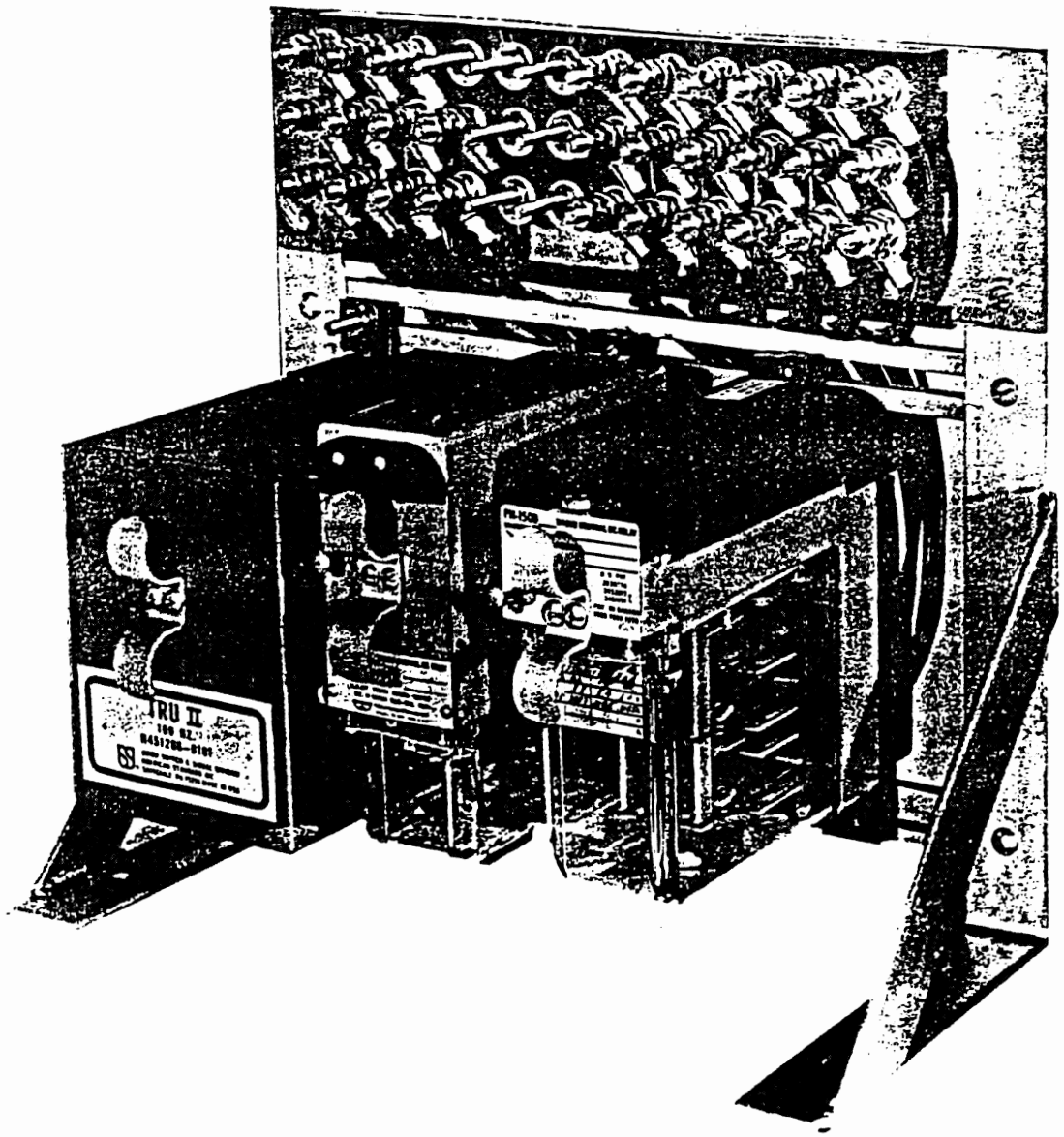
LIST OF ILLUSTRATIONS



Typical TRU-II Rack Installation

SECTION I
GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains the operation, installation and maintenance procedures for the TRU-II 100 Hz unit N451206-0101, the 91.67/100 Hz (91.67 Hz) unit N451206-0103, and the 91.67/100 Hz (100 Hz) unit N451206-0105.

TRU-II is designed to replace all models of the centrifugal track relay. Its primary use is in steady energy track circuit applications in ac propulsion territory. When used in conjunction with a TRU-II Code Reset Unit (Service Manual 6237), the TRU-II may also be applied in single or double direction code overlay applications.

When a track circuit is operating properly, the relay driven by TRU-II will be energized. Track occupancy or system failure will cause the relay to release.

The 100 Hz and 91.67 Hz/100 Hz TRU-II units are plug-in packages. These units are mounted on standard relay equipment racks along with their associated relays. In situations where a wire for wire replacement for a shelf mounted centrifugal relay is desired, a number of mini-racks including TRU-II, relays, and associated components are available.

1.2 EQUIPMENT SPECIFICATIONS

TRU-II Output Relay: PN-150BH, N322511-003

Local Voltage: 110 V or 120 Vac $\pm$10%

Local Current: 50 Ma Range

Track Voltage: 10 Vac Range

Track Current: 100 Ma Range

Dielectric Breakdown Voltage: 3000 V, 60 Hz for one minute

Operating Temperature Range: $-40^{\circ}C$ to $70^{\circ}C$

Overall Dimensions: H=8", W=4-15/16", D=9-1/2"

Mounting: Standard Equipment Rack

Traction Power Environment: DC to 60 Hz AC

Harmonic Immunity: 91.67 Hz unit is immune to 100 Hz

(Fourth harmonic of 25 Hz traction power)

SECTION II
INSTALLATION

2.1 PROCEDURES

For the proper installation of TRU-II refer to Figure 1 or 2 and the appropriate track circuit adjustment table. Proceed as follows.

WARNING

MAKE CERTAIN THAT SIGNAL AND OPERATING POWER TO THE TRU-II UNIT REMAINS OFF UNTIL ALL INSTALLATION PROCEDURES ARE COMPLETE. OTHERWISE PERSONAL INJURY MAY RESULT.

a. Install and connect the track circuit feed equipment as shown on Figure 1 or 2 using the proper settings of the feed transformer, and the feed resistor and or reactor as required (see track tables).

b. Install and connect the track input fuse block and W-400 step-up transformer. Install and connect the local fuse block as shown. Attach a warning label adjacent to the track fuse block with arrows pointing toward the fuse as shown below.

WARNING
THIS FUSE IS PART OF A VITAL SAFETY CIRCUIT. REPLACE WITH 3 AMP BUSSMAN KAB-3 ONLY.

For AC Traction Applications (M451607-6102)

WARNING
THIS FUSE IS PART OF A VITAL SAFETY CIRCUIT. REPLACE WITH ¼ AMP BUSSMAN KTK - ¼ ONLY

For DC Traction Applications (M451639-1101)

c. When mounting TRU-II in our standard equipment rack, bolt the mounting base plate in position beside its associated PN-150BH relay base.

NOTICE

THESE UNITS MUST BE MOUNTED SIDE BY SIDE.

1. Solder connect the track signal lines from the receive transformer secondary winding to TRU-II socket terminals 1 and 2, observing the polarity as shown.

2. Solder connect the local signal lines (110-120 Vac) to TRU-II socket terminals 3 and 4, observing the polarity as shown.

3. Solder connect the PN-150BH relay dc signal lines to TRU-II socket terminals 7 and 8, observing the polarity as shown.

d. When shelf mounting (direct wire for wire replacement of centrifugal relays), place mini-rack at desired location and bolt to shelf. Plug-in TRU-II, PN-150BH relay and its relay repeater.

1. Connect the track signal lines from the track transformer secondary winding terminals to the mini-rack terminals labeled 1T and 2T, observing the polarity shown on Figure 1 or 2.

2. Connect the local signal lines (110-120 Vac) to the mini-rack terminals labeled L1 and L2, observing the polarity shown on Figure 1 or 2.

e. Plug-in the proper local fuse (1 Amp, Bussman NON 1).

f. Plug-in the proper track fuse (3 Amp, Bussman KAB-3 for AC traction) or (1/4 Amp Bussman KTK-1/4 for DC traction)).

WARNING

THE TRACK FUSE MUST BE OF THE CAPACITY AND TYPE SPECIFIED. ANY SUBSTITUTION MAY COMPROMISE THE SAFE PERFORMANCE OF THE TRACK CIRCUIT.

g. Correct phase relation is necessary and is obtained by observing the proper polarities at the transmitting and receiving ends of the track circuit as shown on Figure 1 or 2.

2.2 UNIT OPERATING FREQUENCY CONVERSION

NOTE

The conversion of a 91.67/100 Hz TRU-II unit from 91.67 Hz operation to 100 Hz operation or the conversion from 100 Hz to 91.67 Hz operation requires the unit to be shopped.

a. To convert to 91.67 Hz operation (N451206-0103) the lead wires to inductors L1, L2 and L3 are to be connected to terminals A and C.

b. To convert to 100 Hz operation (N451206-0105) the lead wires to inductors L1, L2 and L3 are to be connected to terminals A and B.

c. The name plate on the front cover should be turned (two sided name plate) to reflect the correct operating frequency and part number.

d. After a frequency conversion is completed, the TRU-II unit must be tested to comply with the operational (shop) specifications.

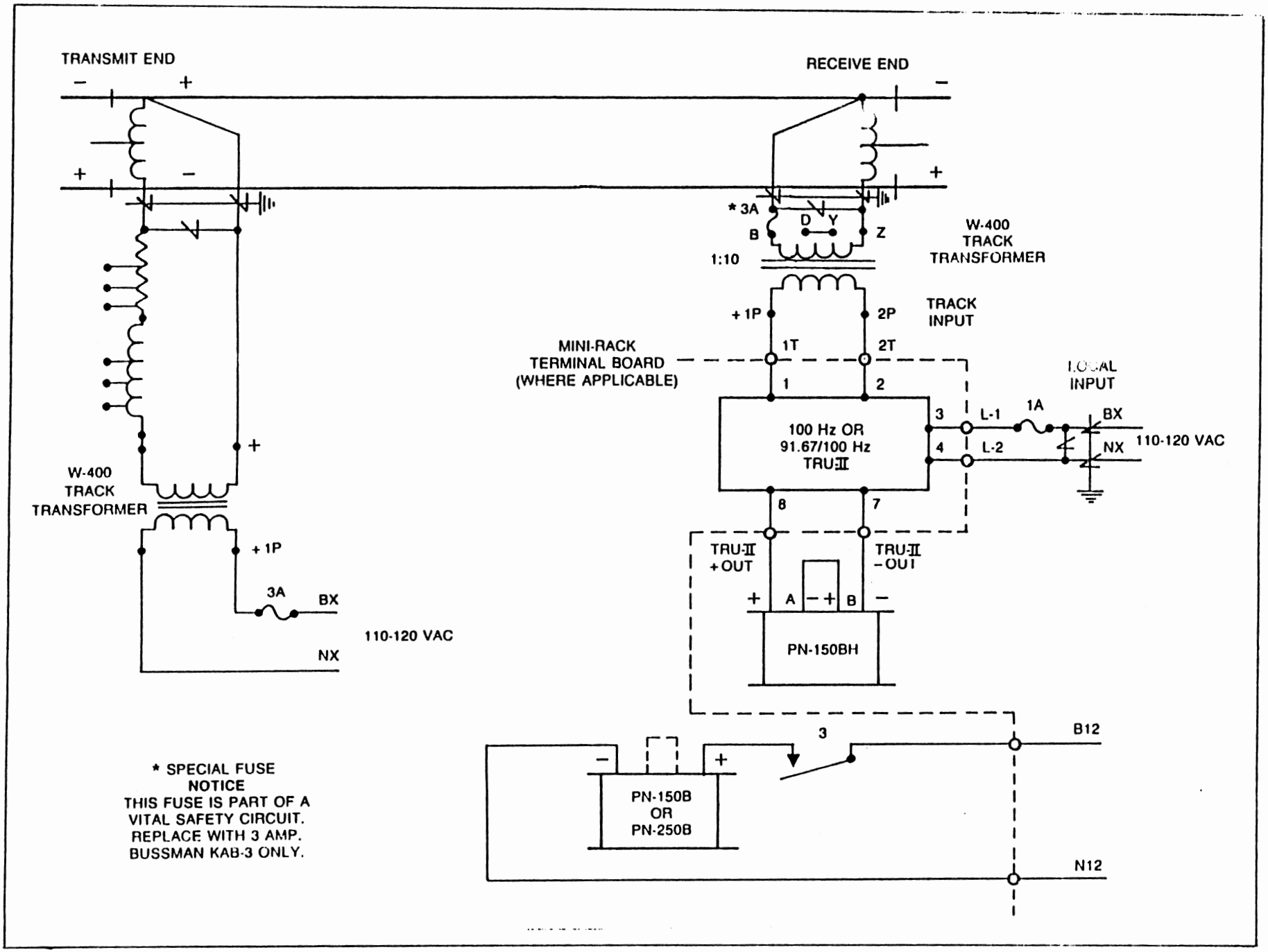


Figure 1. Typical Track Circuit for 100 Hz and 91.67/100 Hz
TRU-II Steady Energy Signal - AC Traction Only

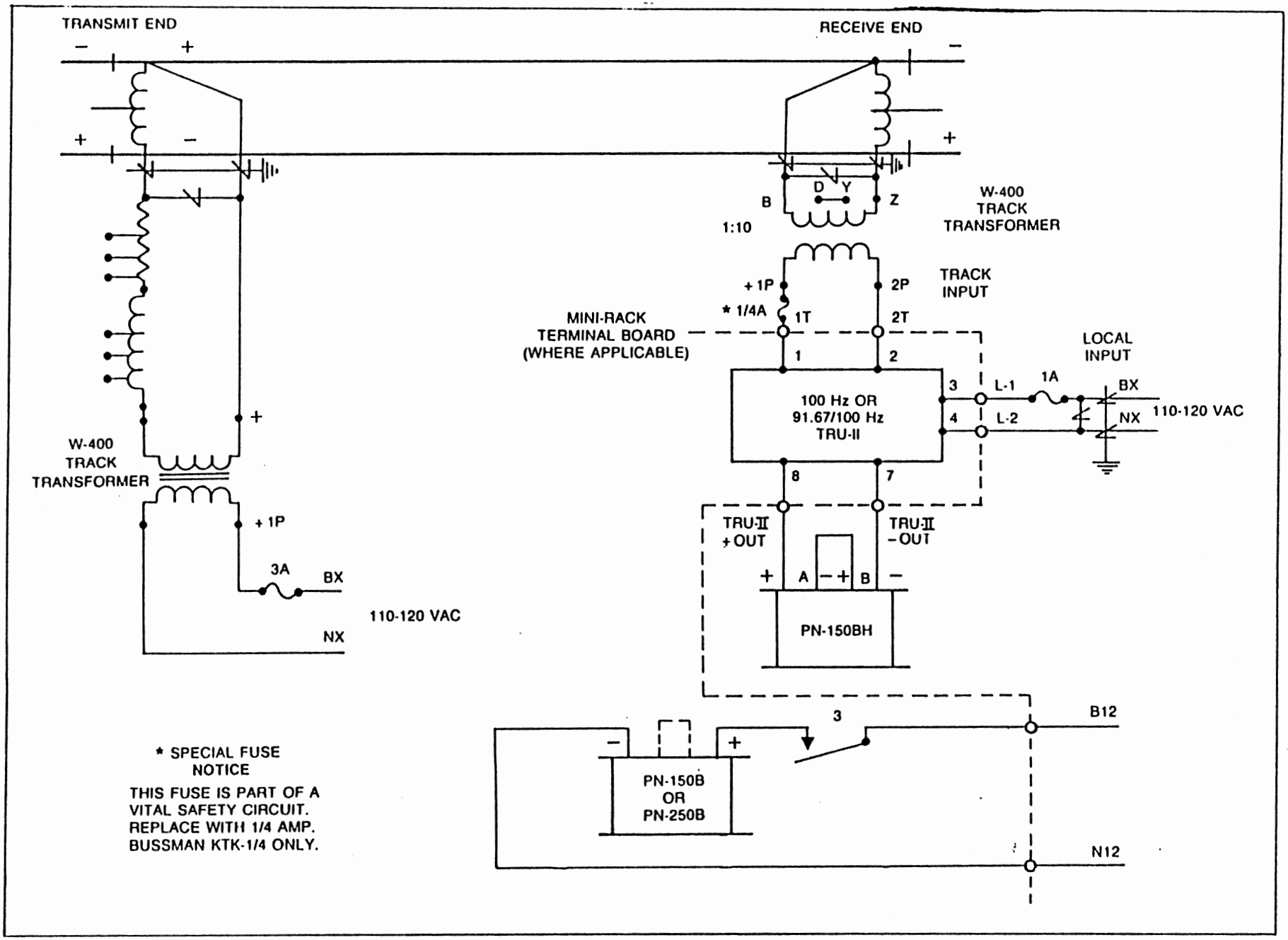


Figure 2. Typical Track Circuit for 100 Hz and 91.67/100 Hz
TRU-II Steady Energy Signal - DC Traction Only

SECTION III
PRINCIPLES OF OPERATION

The TRU-II circuit, including subunit identity is shown on Figure 3. Input from the local signal lines, VL1 (110 Vac RMS) is connected to the primary of Transformer T2. Transformer T2 is a saturable transformer, which in conjunction with the series tuned circuit consisting of inductor L2 and capacitor C2, acts as a voltage regulator, a phase shifter (63° lag), an input filter and an isolation transformer. The track input VT1 (10 Vac RMS range-output from W-400 1:10 track step-up transformer) is connected to step-up transformer T1 through the series tuned filter consisting of inductor L1 and capacitor C1. This filter prevents track input noise and traction power from influencing circuit performance. Two MOV varistors, V1 and V2, are connected across the secondary of transformer T1 in the form of a four terminal network which in conjunction with L1 and C1 provides voltage limiting for track input signals. To swamp out the non-linear loading influence of varistor V3, a heavy shorted turn is incorporated into this transformer to present a low impedance load.

The transformer output signals VT2 and VL2 are series connected and form the drive source for the remaining passive circuit. This circuit includes a noise rejecting series tuned bandpass filter consisting of capacitor C3 and inductor L3. A varistor V3, a full wave rectifier, an instrument fuse, and a relay load complete the circuit loop.

The V-I characteristics of the series connected components, varistor V3, diode bridge rectifier, series tuned circuit, fuse and relay load is illustrated on Figure 4. In the presence of local input only, the output of Transformer T2 secondary (VL2) is applied to the circuit loop and produces a small current output vector (well below the relay pick-up level) as shown. When a track input of about equal amplitude at Transformer T2 secondary (VT2) is applied in phase with VL2, the two voltages add in phase and produce a large current vector as shown. As a result of the non-linear circuit transfer characteristics, adding two input voltage vectors, produces a total current roughly proportional to their voltage product. This calculation is performed similar to the manipulation of a conventional slide rule. The actual current through the biased relay is pulsed dc produced by the full wave rectifier.

The instrument fuse is to provide protection for varistor V3. Under normal operating conditions, this fuse cannot be blown, regardless of the signal amplitude level or frequency that is applied to the TRU-II local or track inputs. Capacitor C4 provides for transient suppression. Transformers T1 and T2 are provided with multiple taps to provide for shop calibration.

The dashed windings on inductors L1, L2 and L3 apply to the 91.67/100 Hz TRU-II units only. When these TRU-II units are to be adjusted for 91.67 Hz operation (N451206-0103), the inductor connections are made to terminal C. When these TRU-II units are to be adjusted for 100 Hz operation (N451206-0105), the inductor connections are made to terminal B.

There are no TRU-II internal or external adjustments for track length compensation. All track adjustments are made at the track feed end.

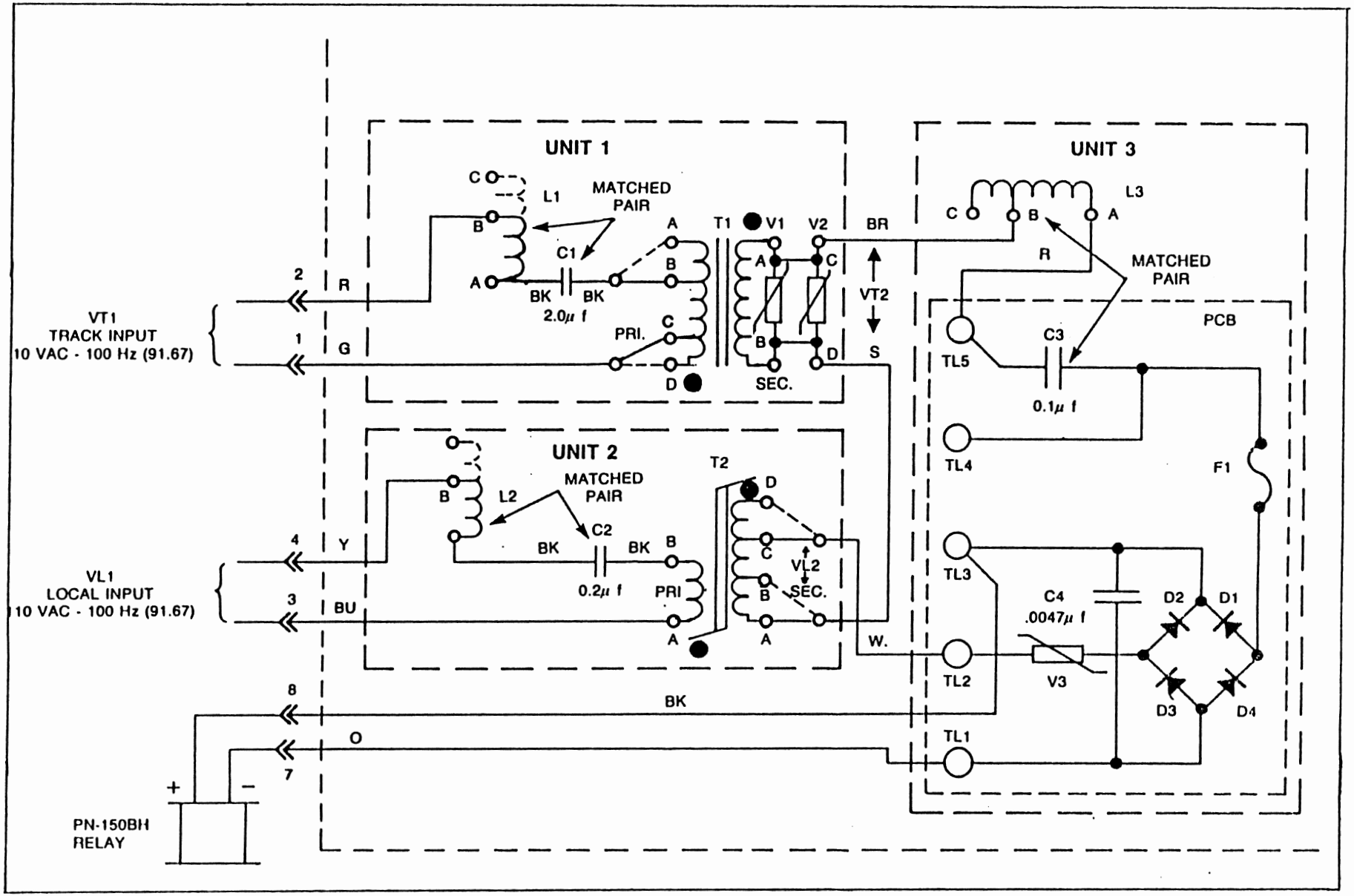


Figure 3. TRU-II Circuit Diagram

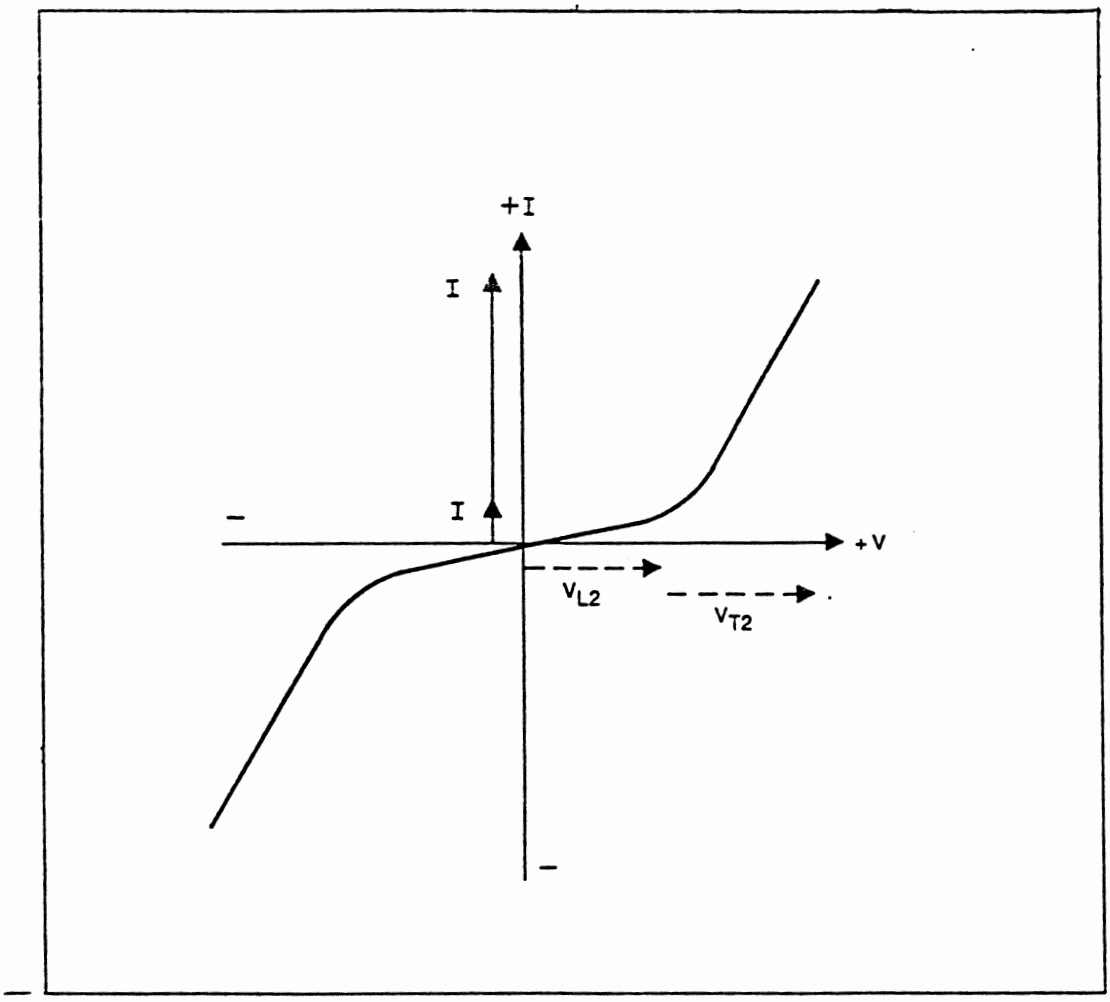


Figure 4. V-I Characteristics

SECTION IV
MAINTENANCE AND TEST PROCEDURES

4.1 GENERAL

Initial checks of the 100 Hz or 91.67/100 Hz TRU-II consists of voltage readings taken across selected external terminals.

A TRU-II unit suspected of being defective should be replaced with one known to be in working order. If a unit is found to be defective, it should be shopped for repair or returned to US&S for repair or replacement.

No TRU-II unit field repairs should be attempted.

WARNING

EXTREME CARE SHOULD BE EXERCISED DURING "POWER-ON" TESTS OF THE TRU-II UNIT. CONTACT WITH THE UNIT TERMINALS MAY RESULT IN PERSONAL INJURY.

4.2 FIELD CHECKS

NOTE

The TRU-II, like all vital safety devices, must be field tested periodically to ensure safe operating limits. We recommend that it be tested every two years. If the unit does not perform as specified, the unit should be replaced and the faulty unit returned to the shop for repairs.

a. Required test equipment: Simpson 260 Analyzer (or equivalent, 20,000 ohm/volt).

b. Check that the TRU-II unit and associated equipment is properly installed, including the condition and tightness of all terminal connections.

c. Measure the voltage across the TRU-II track input socket terminals 1 and 2. (When applying mini-racks, measure this voltage between rack terminals T1 and T2.) The voltage should be steady energy 100 Hz (91.67 Hz) at about the 10 to 15 Vac RMS level when the track circuit is not shunted.

d. Measure the voltage across the TRU-II local input socket terminals 3 and 4. (When applying mini-racks, measure this voltage between rack terminals L1 and L2). The voltage should be steady energy 100 Hz (91.67 Hz) at about the 110 to 120 Vac RMS level.

e. Measure the voltage across the TRU-II output socket terminals 7 and 8. (When applying mini-racks, measure this voltage between rack terminals designated TRU-II + Out and TRU-II - out). The output voltage is pulsed dc which should read an average voltage of 12 to 16 Vdc when the track circuit is not shunted.

WARNING

ACCIDENTLY SHORTING THE TRU-II OUTPUT TERMINALS MAY BLOW THE TRU-II INTERNAL INSTRUMENT FUSE. REPLACEMENT OF THIS FUSE REQUIRES SHOPPING THE UNIT.

f. Remove the 3 amp. track fuse and, using the Simpson 260 multimeter adjusted to the 10 volt scale, measure the TRU-II output voltage across output socket terminals 7 and 8. (When applying mini-racks, measure this voltage between rack terminals designated TRU-II + out and TRU-II - out.) The output level should not exceed +2.5 volt dc.

4.3 OPERATIONAL (SHOP) TESTS

NOTE

Shop tests must be performed on all TRU-II units sent to the shop for repair or spec. verification before returning them to service.

a. Required test equipment (or equivalent):

- o Voltmeter (V1), ac, 0-150V, Fluke 8050A Digital Multimeter
- o Voltmeter (V2), ac, 0-30-60V, Weston 433-1913004
- o Milliammeter, ac, 0-75 Ma, Weston 433-4913005
- o Voltmeter (V3), dc, 0-30V, Weston 931-1916003 (5000 ohm/volt)
- o Hewlett-Packard frequency meter made up of H.P. 5300 measuring system and a 5307A high resolution counter
- o Wavetek 115 oscillator
- o McIntosh 2100 audio amplifier
- o Four 1.5K, 25 watt resistors
- o Two variacs, General Radio 5A
- o One US&S W-400 Transformer, Type N451428-0101
- o Miscellaneous switches shown on Figure 5

- Three phase "Y" connected Electronic Power Supply Generator 450 V.A., 150 VA per phase 0-130V, 1.2 amps per phase, Behlman Engineering Corp., Mod. 3-10-C-D. Behlman plug-in oscillator Mod. OSCD-3-45/200-G

- One US&S PN-150BH Relay, Type N322511-003

b. Wiring and Level Adjustment Test

1. Connect test instrumentation as shown on Figure 5. Note the phase arrangement of the three phase power source. Phase 2 lags Phase 1 by 120° and Phase 3 lags Phase 2 by 120°.

2. Put the inverter switch in the invert position, the phase select switch to position 3, the track input switch to normal and the interference frequency switch to the "off" position.

3. With the power supply level set to zero, turn the output switch on the power supply to the "ON" position. Adjust the power source frequency to the value required (Table 1) for the TRU-II model being tested.

CAUTION

The Electronic Power Supply should have its output level set to zero before turning the input power "on" or "off" to avoid possible equipment damage. See power supply instruction manual.

4. Adjust power supply voltage level to 110 Vac as indicated by voltmeter V1 across the local input. Adjust #1 variac so that the track input voltage indicates 10 V on voltmeter V2. The TRU-II output voltage indicated on voltmeter V3 should read as shown on Item 1, Table 1.

5. If the TRU-II dc output level is outside the spec. range, it may be adjusted by referring to Figure 3 and the following tabulation.

TRU-II Output Level	Transformer T2 Secondary Taps
Low	B & C
Med.-Low	B & D
Med.-High	A & C
High	A & D

c. Regulation Test

1. Leave all switch and level settings the same as in Section 'b' above. The local input current and TRU-II output voltage should equal the values shown on Table 1, Item 1.

2. When the power source level is increased to 130 volts and the track level is adjusted to 11 volts, the local current and output voltage should equal the values shown on Item 2, Table 1.

3. When the power source is decreased to 90 volts and the track level is adjusted to 9 volts, the local current and output voltage should equal the values shown on Item 3, Table 1.

d. Track Phase Test

1. Leave all switch and level settings the same as in Section 'b' above. Adjust the power source to 110 volts.

2. Using variac #1 adjust the track input voltage to a level which results in a TRU-II dc voltage output level of 10.0V.

3. Turn the inverter switch to the normal position and th phase select switch to position 1. The TRU-II output voltage should equal the value shown on Item 1, Table 2.

4. Turn the phase select switch to position 2. The output should equal the value shown on Item 2, Table 2.

5. Turn the phase select switch to position 3. The output should equal the value shown on Item 3, Table 2.

e. Track Input Limiter Test

1. Leave all switch and level settings the same as in Section 'b' above. Adjust the power source to 130 volts.

2. Turn the track input switch to the overload position and adjust the track input V2 to 22 volts. The TRU-II output voltage should equal the value shown on Table 3.

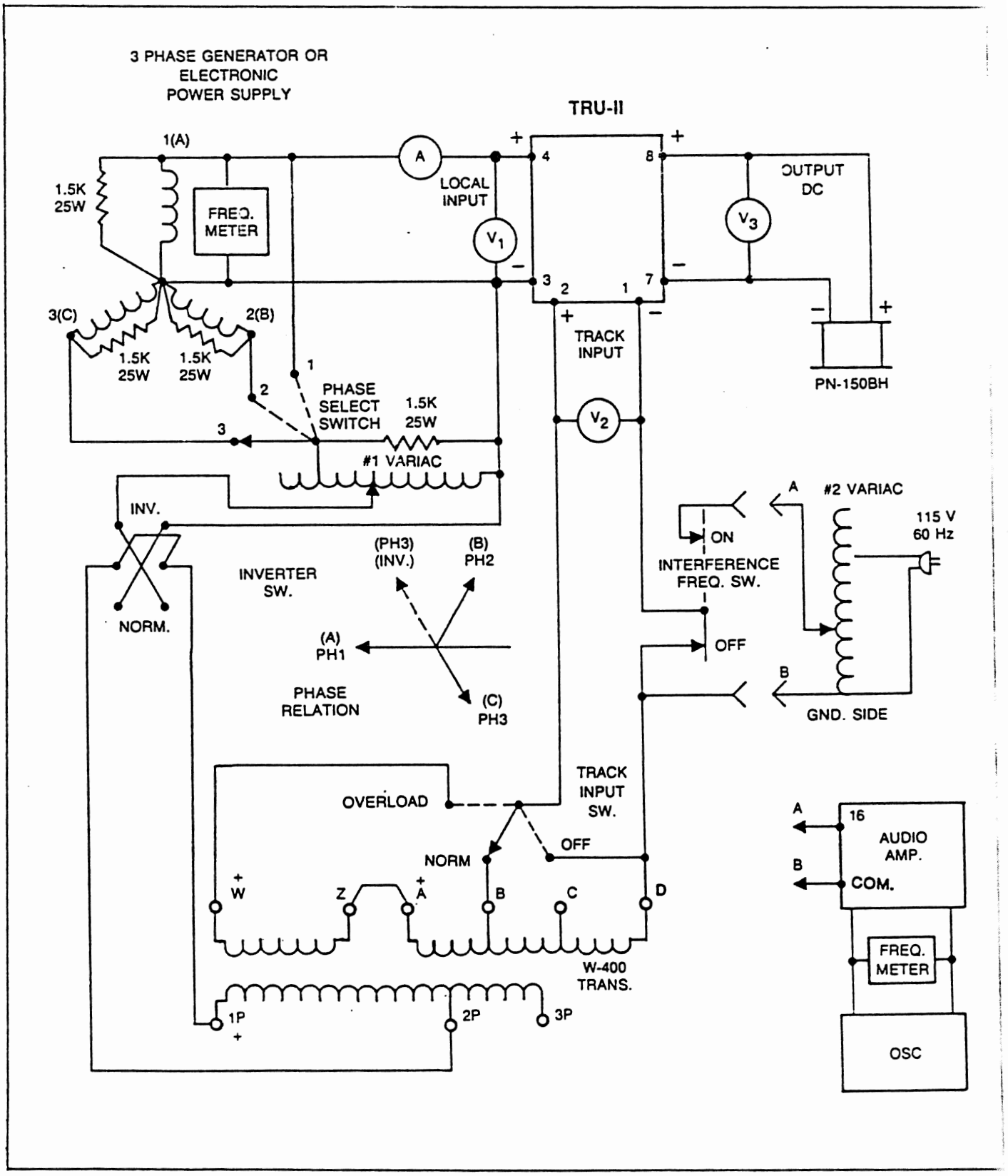


Figure 5. Test Set-up

f. Traction Current Safety Test

1. Leave all switch and level settings the same as in Section 'b' above. Place the track input switch to the "off" position and the interference frequency switch to the "on" position.

2. With variac #2 connected as shown on Figure 5 and set to zero, increase the variac output so that the track input voltage reads 50 volts. The TRU-II output equal the value shown on Item 1, Table 4.

g. Traction Current Imbalance Tolerance Test

1. Leave all switch and level settings the same as Section 'f' above. Adjust variac #2 so that the track input reads 50 volts.

2. Turn the track input switch to normal. The TRU-II output should read as shown on Item 2, Table 4.

h. 100 Hz Safety Test (For 91.67 Hz Unit Only)

1. Leave all switch and level settings the same as Section 'g' above. In place of #2 variac, connect the audio oscillator and amplifier shown on Figure 5.

2. Using a frequency meter, adjust the oscillator frequency to 100.0 Hz.

3. Increase the amplifier output voltage until the track input V2 reads 50 volts. The TRU-II output should read as shown on Item 3, Table 4.

5.4. COMPONENT (SHOP) TESTS

a. General

Tests on individual subassemblies and components of the 100 Hz and 91.67 Hz TRU-II requires removing the cover and disconnecting the unit from all external connections. Make certain during reassembly that all parts and wiring connections are returned to their correct locations.

NOTE

When assembly is complete, the unit must be subjected to the tests described in Section IV (Operational Tests) before the unit is put back into service. Refer to TRU-II general drawing on Figure 3.

Table 1. Wiring and Regulation Test

Item No.	Power Source Freq. Hz	Power Source (Local) VAC (RMS)	Track Input VAC (RMS)	Local Input Current Milliamps	TRU-II Output V.D.C.
1.	100.0	110.0	10.0	42-58	13 - 15
	91.67	110.0	10.0	42-58	13 - 15
2.	100.0	130.0	11.0	45-62	13.5-15.6
	91.67	130.0	11.0	45-62	13.5-15.6
3.	100.0	90.0	9.0	38-53	12.1-14.0
	91.67	90.0	9.0	38-53	12.1-14.0

Table 2. Track Phase Test

Item No.	Power Source Freq. Hz	Phase Select Switch Position	TRU-II Output V.D.C.
1.	100.0	1	7.0 - 8.3
	91.67		7.0 - 8.3
2.	100.0	2	6.0 - 7.5
	91.67		6.0 - 7.5
3.	100.0	3	0.5 - 2.0
	91.67		0.5 - 2.0

Table 3. Track Input Limiter Test

Power Source Freq. Hz	Track Input VAC (RMS)	TRU-II Output V.D.C.
100.0	22	15 - 19
91.67	22	15 - 19

Table 4. Traction Current Safety Test, Traction Current Imbalance Test and 100 Hz Safety Test

Item No.	Power Source Freq. Hz	Track Freq. Hz	Track Input VAC (RMS)	TRU-II Output V.D.C.
1.	100.0	60	50.0	3.0 - 6.0
	91.67	60	50.0	3.0 - 6.0
2.	100.0	60	50.0	10.5 - 14.5
		100	10.0	
	91.67	60	50.0	10.5 - 14.5
		91.67	10.0	
3.	91.67	100.0	50	7.0 - 9.5

b. Test Procedure for TRU-II Series Tuned Circuits

1. Required test equipment (or equivalent):

   Hewlett Packard 200AB Oscillator,
   Tektronix 434 two channel oscilloscope,
   Decade Resistor Box 0-100 ohm, ±5%,
   Decade Resistor Box 0-10K ohm, ±5%,
   Amplifier, McIntosh 2100,
   Hewlett Packard High Resolution Frequency Counter 5307A,
   Digital Ohmmeter, Fluke 8050A multimeter.

2. Measure an inductor's dc resistance value and compare it to the value listed on Table 5.

3. To perform an operational test on a tuned circuit, electrically isolate the circuit from its surrounding circuitry by disconnecting the lead wire shown on Table 5 and connect the tuned circuit (inductor-capacitor combination) into the test circuit shown on Figure 6.

4. Adjust both oscilloscope trace lines so that their ground levels are on the middle horizontal line.

5. Adjust the decade resistor to the required value shown on Table 5.

6. Adjust the input voltage to the level shown on Table 5. Maintain this level throughout the test.

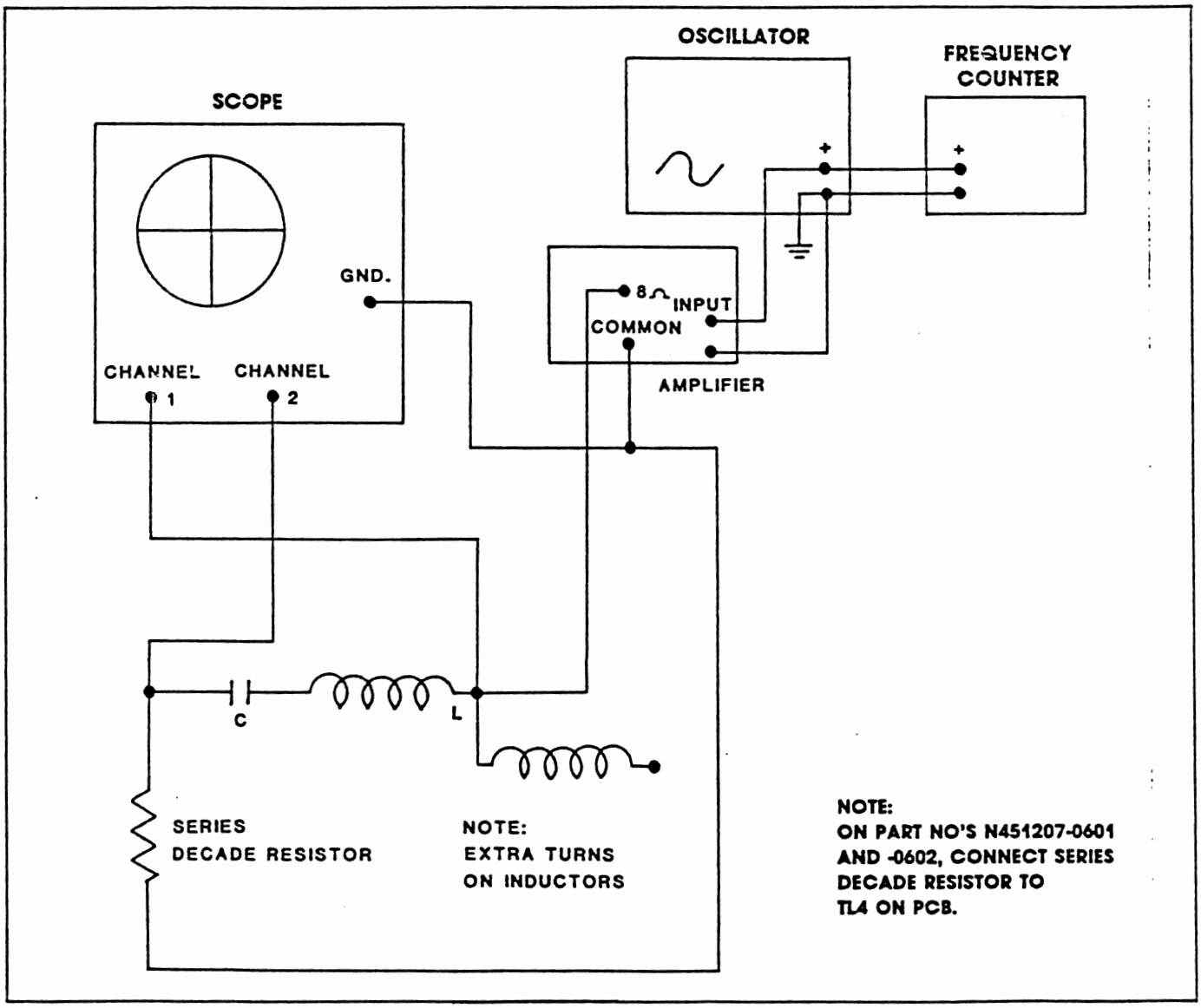


Figure 6. Tuned Circuits Test Set-up

7. Adjust the oscillator frequency so that the oscilloscope trace appears as shown on Figure 7. The tuning point should be within the frequency range shown on Table 5.

NOTE

On units N451207-0502, 0602 and 0702 connect the full inductor winding for test purposes.

NOTE

If an inductor or capacitor is found to be defective, both must be replaced since they are assembled and tested as a matched pair.

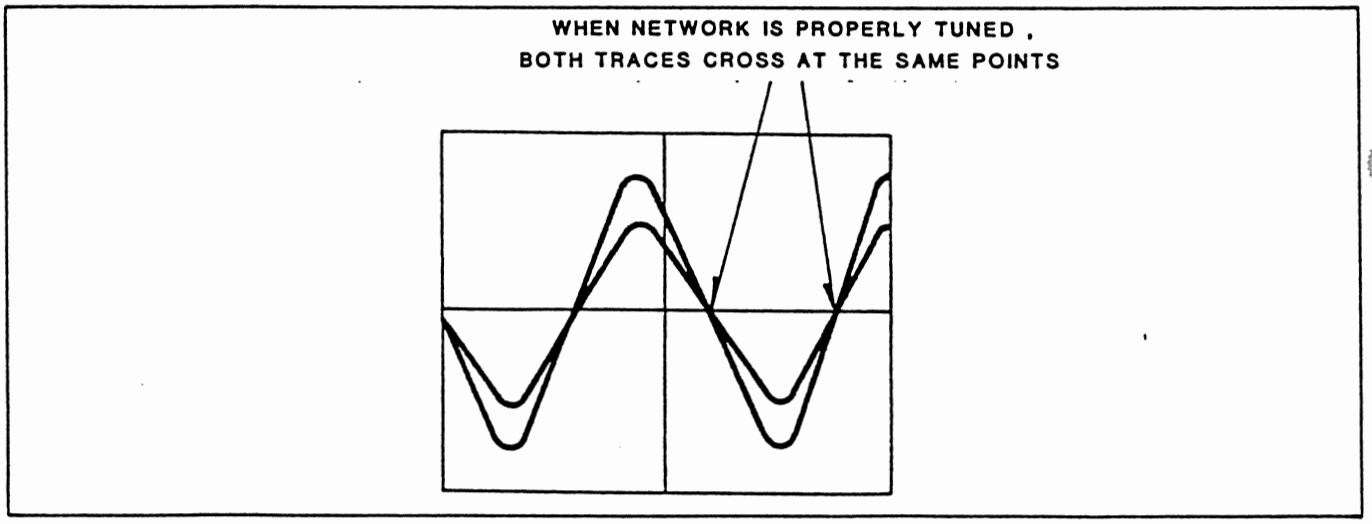


Figure 7. Oscilloscope Trace

Table 5

Subassembly Unit No.	Disconnect Lead Wire For Test	DC Resistance Start to Inductor Tap Min. (Ohms)	DC Resistance Start to Inductor Tap Max. (Ohms)	DC Resistance Start to End Min. (Ohms)	DC Resistance Start to End Max. (Ohms)	Tuning Pt. LC Network Start to Inductor Tap Min. (Hz)	Tuning Pt. LC Network Start to Inductor Tap Max. (Hz)	Tune Pt. LC Network Start to End Min. (Hz)	Tune Pt. LC Network Start to End Max. (Hz)	Level of AC Input Ch1	AC Output Ch2	Resistance of Series Decade Resistor
#1 N451207-0501	Red	no tap		18.9	20.9	no tap		100.2	101.8	22.4Vp-p	11.0-12.2V.P.P.	45 ohms
#3 N451207-0601	Brown	no tap		119.5	131.5	no tap		102.2	103.8	40Vp-p	27.5-30.5V.P.P.	2K ohms
#2 N451207-0701	Yellow	no tap		50.6	55.6	no tap		92.0	93.6	30Vp-p	11.4-14.0V.P.P.	1K ohms
#1 N451207-0502	Red	18.9	20.9	20.5	22.9	100.2	101.8	91.5	93.5	22.4Vp-p	11.0-12.2V.P.P.	45 ohms
#3 N451207-0602	Brown	119.5	131.5	130	144	102.2	103.8	93.5	95.5	40Vp-p	27.5-30.5V.P.P.	2K ohms
#2 N451207-0702	Yellow	50.6	55.6	55	60.8	92.0	93.6	83.7	85.7	30Vp-p	11.4-14.0V.P.P.	1K ohms

c. Test Procedure for TRU-II Transformers

1. Required test equipment (or equivalent):

   Wavetek 115 Oscillator,
   Tektronix 434 two channel oscilloscope,
   Decade Resistor Box 0-100 ohm, ±5%,
   Decade Resistor Box 0-10K ohm, ±5%.

2. Measure the transformer primary and secondary winding resistances and compare them to the values listed on Table 6.

3. To perform an operational test on a transformer, electrically isolate it from its surrounding circuitry by disconnecting one end of the slate lead wire connecting the transformer secondary windings. Then connect the transformer into the test circuit shown on Figure 8.

4. Adjust R1 and R2 to the values shown on Table 6. Adjust the oscilloscope frequency to 100 Hz and its output voltage level to the value shown on Table 6.

5. Using an oscilloscope, measure the voltage level across R1, Coil A and Coil B. The waveforms in all cases should be harmonic free sinewaves. The signal voltage amplitude should be within the range shown on Table 6.

NOTE

There are two varistors connected across the secondary coil of Transformer T1. These varistors (a matched pair) are connected in a four terminal safety circuit. If one varistor is found to be defective, both varistors must be replaced. See the matched pair ordering number on the parts list. When varistors are replaced, the wiring and component connections must be exactly the same as the original with no alterations.

NOTE

The varistors on the secondary of transformer should not influence the resistance or voltage tests since their resistive load is negligable at the test voltage levels. If the transformer voltage measurements are not correct, disconnect one side of the varistor which is connected to coil terminals A and B and repeat the transformer test.

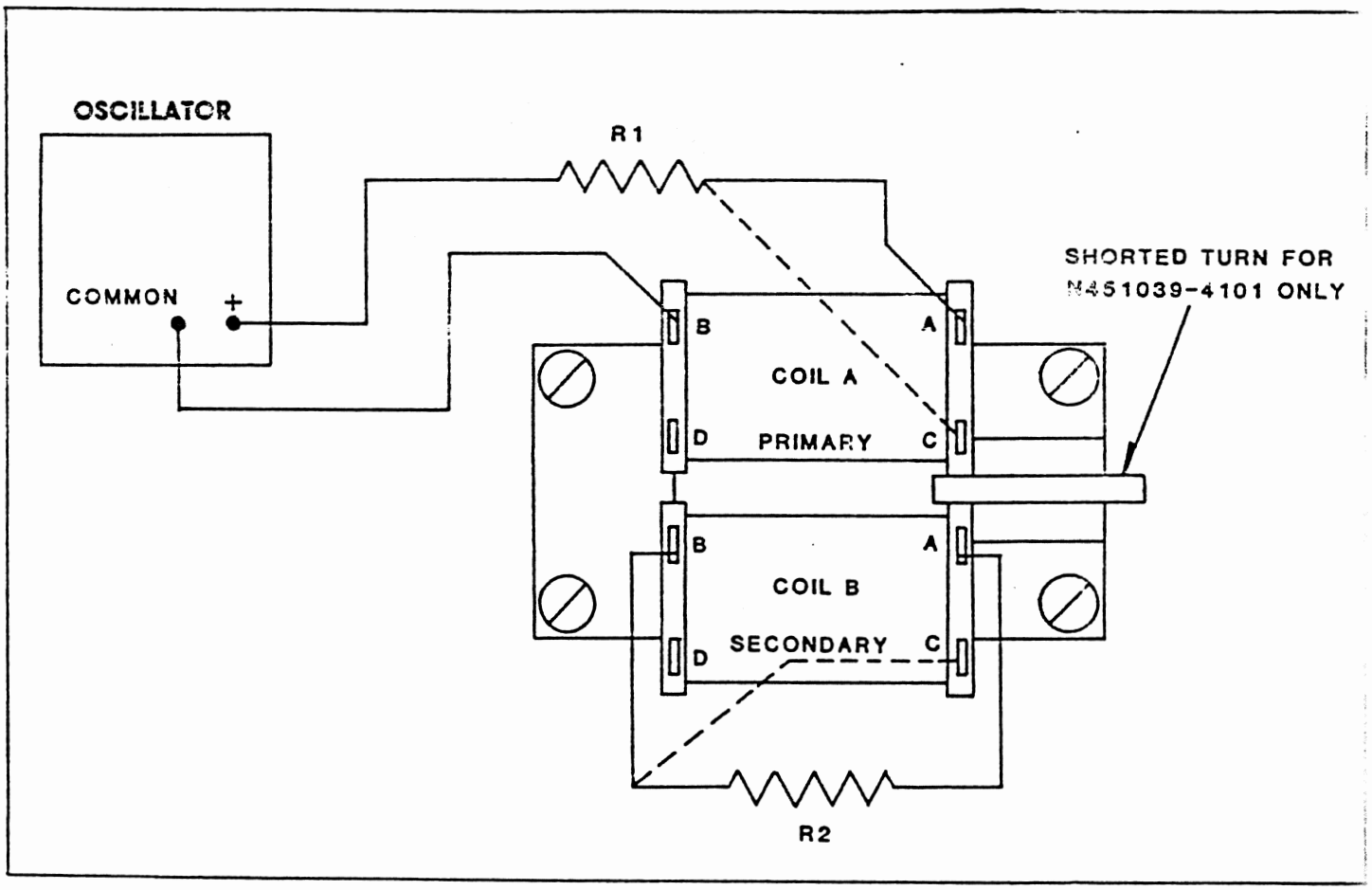


Figure 8. Transformer Test Set-up

d. Test procedure for track input varistor limiter.

1. Required test equipment (or equivalent) same as Section 'c'.

2. Inspect both track input limiter varistors (V1 and V2) for mechanical damage.

3. Check all varistor electrical connections.

4. To electrically test the track input varistor limiters, isolate Transformer T1 from the unit by disconnecting the slate wire on terminal D of the secondary winding.

5. Connect the transformer into the test circuit shown on Figure 7.

6. Adjust R1 and R2 to the values shown on Table 6 (T1 with varistor limiters). Adjust the oscillator frequency to 100 Hz and its output level to the value shown on Table 6.

7. Using an oscilloscope, measure the clipped peak-to-peak voltage across coil B. The voltage level should be within the range shown on Table 6.

Table 6

Transformer No	Coil Res. (Ohms) Coil A (Primary)	Coil B (Secondary)	R1 Ohms	R2 Ohms	Osc. Out Volts P-P	R1 Volts P-P	Coil A (Pri.) Connections	Coil A (Pri.) Volts P-P	Coil B (Sec.) Connections	Coil B (Sec.) Volts P-P
T1 N451039-4101	Term A to D 3.17 To 2.87	Term A to B 164 To 148	50	6,000	15	6.9 To 7.6	B & C	7.8 To 8.5	A & B	48 To 53
T1 N451039-4101 (With Varistor Limiters)	--	--	50	6,000	30	--	B & C		A & B	66 To 80
T2 N451039-4102	Term A to B 2.60 To 2.34	Term A to D 2.94 To 2.66	2,000	2,000	30	18.9 To 20.3	A & B	9.4 To 11.8	A & C	9.5 To 10.5

NOTE

The transformers secondary windings as shown in Figure 3 appear to be connected in opposing phase. This is intended so that the saturable transformer T2, which provides a very large phase lead, and Transformer T1 have the proper phase relation to each other.

e. Test and adjustment procedure for Unit 1 subassembly.

NOTE

This procedure must be followed when any component in Unit 1 subassembly is replaced.

1. Required test equipment (or equivalent):

   Voltmeter, ac, (V1), Fluke 8050A Digital Multimeter,
   Milliammeter, ac, 0-150 Ma, Weston 433-4913005,
   Voltmeter, ac, (V2), Fluke 8050A Digital Multimeter,
   Frequency Meter Hewlett Packard 5300 with 5307A,
   Oscillator, Wavetek 115,
   Audio Amplifier, McIntosh 2100,
   Decade Box 0-10K Ohms, ±5%.

2. Disconnect the slate wire on Terminal D of Transformer T1 secondary winding and connect the test instrumentation as shown on Figure 9. (The primary connections to Transformer T1 will vary depending on original calibration.)

3. Adjust the frequency to 100 or 91.67 Hz as required, the resistance of R to 4.8K and V1 to 9.0 Vac RMS.

4. The input current should read within the 94-102 Ma. range. The output voltage, V2 should read within the 27.4 - 33.6 volt range.

5. If the current level is outside the 94-102 Ma. range, adjust the wire to the tap connections according to the following list.

Current Level	Black Wire	Green Wire	
Highest	B	C	
High	B	D	Taps
Medium	A	C	
Low	A	D	

f. Test procedure for printed circuit board.

Required test equipment (or equivalent):

Decade Resistor Box 0-10K Ohms, ±5%,
DC power supply, 0-50 Volt with coarse and fine level adjustment,
Oscillator, Wavetek 115,
Oscilloscope with dc capabilities,
Digital Multimeter, Fluke 8050A

1. Inspect the board for damage and loose solder connections.

2. Disconnect the white wire from TL2.

3. Connect the oscillator output to turret lugs TL2 and TL5 of the PCB. Connect a 2K resistor load across TL1 and TL3. Adjust the oscillator output to 1000 Hz frequency and 30 volts p-p.

4. With the oscilloscope ground connected to TL1, measure the signal voltage across TL1 and TL3. The signal should appear similar to Figure 10 and its amplitude range should be 1.8 to 3.4V p-p.

NOTE

When testing the printed circuit board do not grossly exceed the 30 V p-p test input, since doing so may blow fuse F1. Be sure that the oscillator output is not connected to ground via the ground strap.

5. Disconnect the oscillator and oscilloscope. Do not disconnect the 2K resistor from TL1 and TL3. Connect the 50 volt dc power supply output across TL4 and TL2. Do not turn on power supply. Connect the digital voltmeter across the 2K resistor TL1 and TL3. Adjust the power supply output to the minimum level. Turn on the supply and slowly increase the output voltage until the voltmeter reads 20.0 ±0.1 volt. Measure the voltage across varistor V3 by connecting the digital voltmeter to TL2 and the cathode (side with the black stripe) of diode D3. The output voltage should range from 23.0 to 31.1 volts.

6. Connect the dc power supply and the 2K resistor as in Test No. 5 above. Connect the digital voltmeter to TL2 and the cathode of D3. Adjust the power supply so that the voltmeter reads 20.25 ± 0.1 volts. Measure the voltage across the 2K resistor. This output should read in the 0 to 1.8 Vdc range.

NOTE

When replacing Fuse F1, allow 1/4" lift-off from the printed circuit board. Fuse F1 is part of a vital safety circuit. Replace with a 1/64 amp. J710143 fuse only. If fuse F1 is open, replace it and perform a complete TRU-II operational (shop) test.

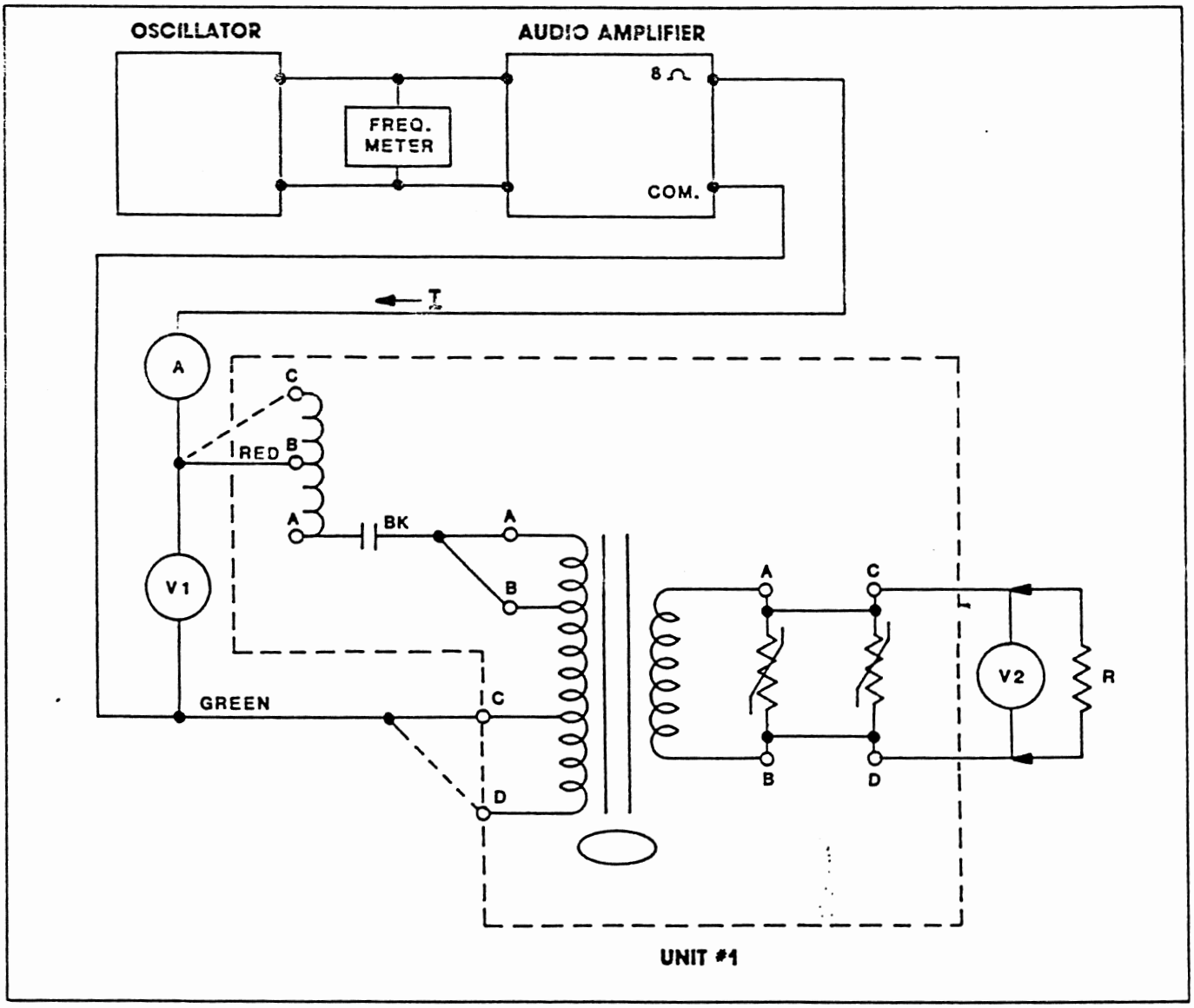


Figure 9. Unit #1 Subassembly Test Set-up

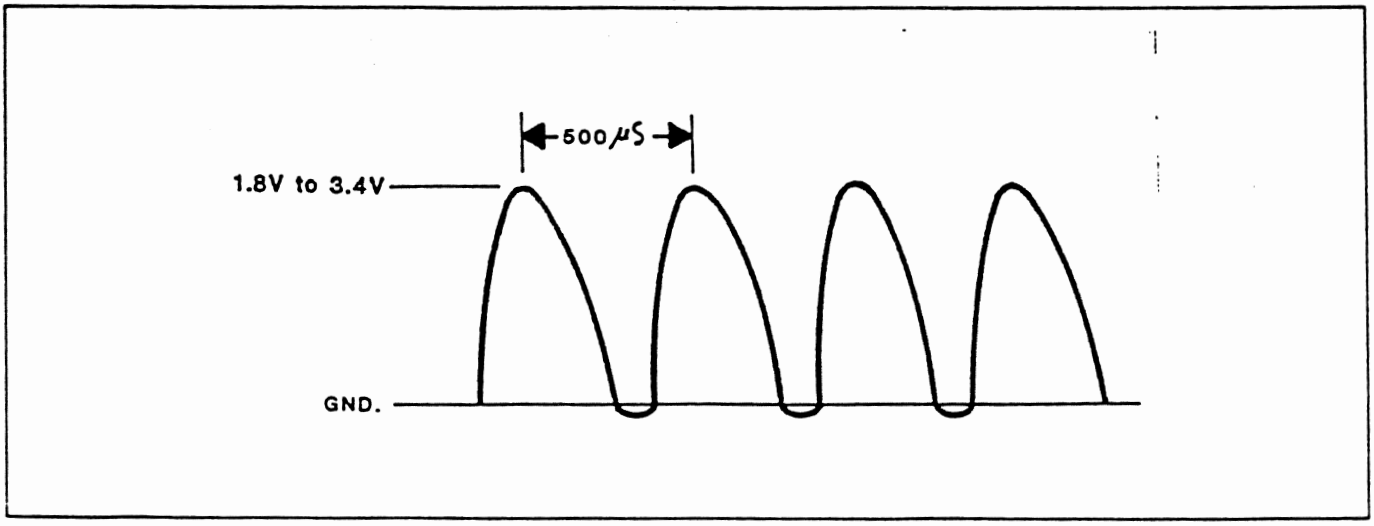


Figure 10. Signal Voltage Waveform

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SERVICE MANUAL 6236

APPENDIX A

PARTS LIST

TRU-II AC TRACK UNIT

100 Hz and 91.67/100 Hz

June, 1984
ID00044D/DN0411A
A-6/91-2449-3

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APPENDIX A
PARTS LIST

This section provides a listing of 100 Hz and 91.67/100 Hz TRU-II ac track unit parts. Replacements for all parts may be obtained through US&S field offices. However, certain of the standard electronic components may be obtained from outside sources.

CAUTION

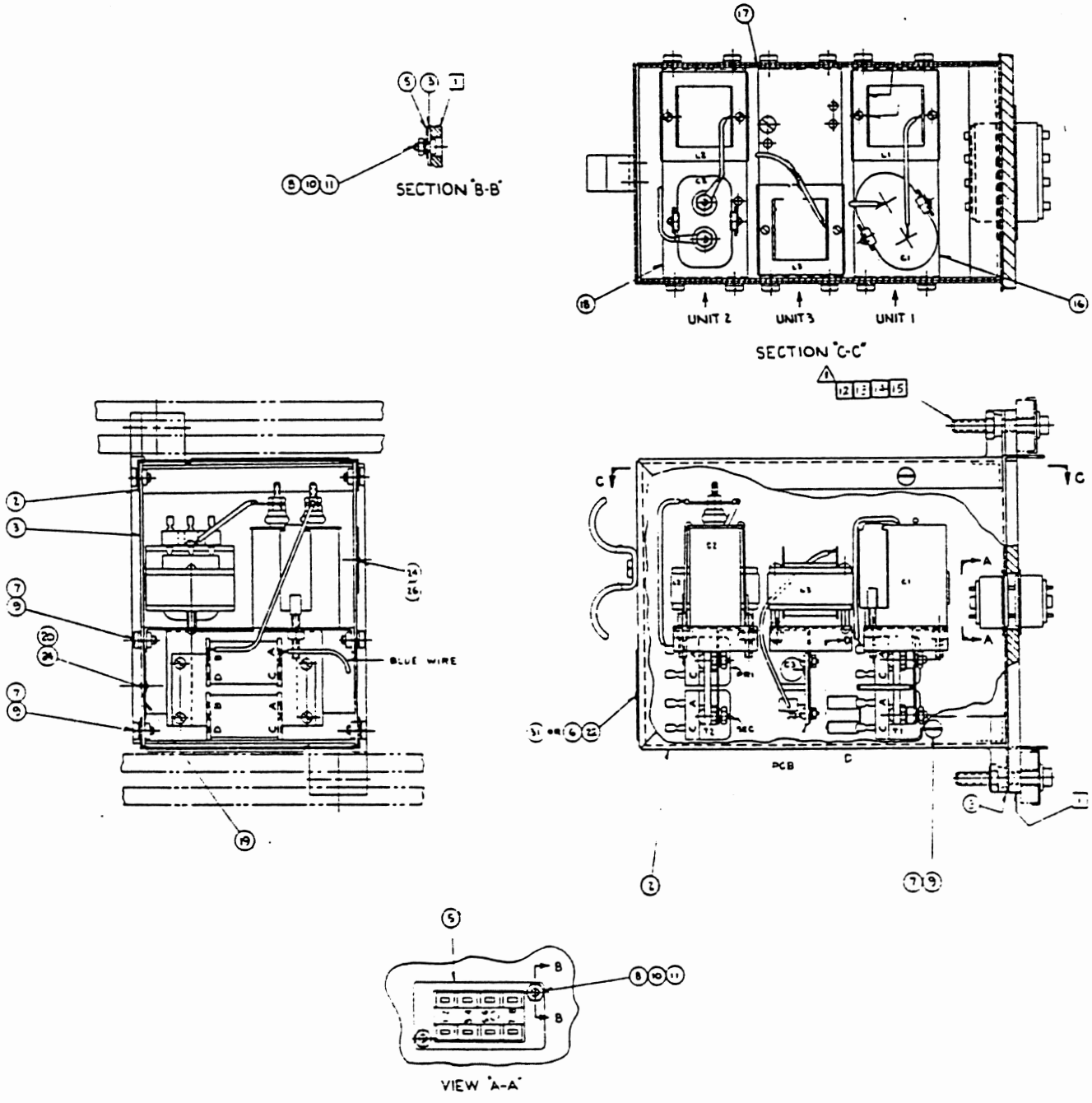
BEFORE REPLACING ANY STANDARD ELECTRONIC COMPONENTS WITH ONES FROM SUPPLIERS OTHER THAN US&S, CHECK THE PARTS LIST TO OBTAIN THE CORRECT VALUE, TOLERANCE, RATING AND DESCRIPTION FOR THE COMPONENT. ALL REPLACEMENTS SHOULD BE EXACT REPLACEMENTS UNLESS IT IS CLEARLY KNOWN THAT A DIFFERENT COMPONENT WILL NOT ADVERSELY AFFECT SYSTEM PERFORMANCE. THE WRONG COMPONENT MAY CAUSE IMPROPER OPERATION OF THE SYSTEM OR RESULT IN EQUIPMENT DAMAGE.

It is important to remember that the physical size and shape of a replacement component must be considered and must be equivalent to the original, otherwise the performance of the replacement may be affected (particularly at high frequencies).

PARTS LIST FOR TRU-II PLUG-IN UNIT
Part No's. N451206-0101, -0103, and -0105*
(See Figure A-1)

ITEM NO.	DESCRIPTION	PART NUMBER
1	Mounting Plate	N451207-0202
2	Cover	N451207-0302
3	Body	N451207-0102
5	Plug, Eight Connector Male	J071878
6	Nameplate (Suffix -0101 Only)	M451496-7801
7	Screw, 10-32 x 3/8 Pnh., St.	J507266
8	Screw, 8-32 x 3/8 Pnh., St.	J050985
9	Washer, 10 Stl. Lk., Med.	J047733
10	Washer, 8 Lk.	J047681
11	Nut, 8-32 Hex., Stl.	J048166
12	Bolt, 14-24 x 1-7/8	M115706
13	Washer, 3/16 Pl.	J047500
14	Nut, 14-24 (AAR)	J480301
15	Clamp	M381298
16	TRU-II, Unit 1 (Suffix -0101 Only)	N451207-0501
	TRU-II, Unit 1 (Suffix -0103 Only)	N451207-0502
17	TRU-II, Unit 2 (Suffix -0101 Only)	N451207-0701
	TRU-II, Unit 2 (Suffix -0103 Only)	N451207-0702
18	TRU-II, Unit 3 (Suffix -0101 Only)	N451207-0601
	TRU-II, Unit 3 (Suffix -0103 Only)	N451207-0602
19	Warning Plate	M451607-6101
20	Washer, SST.	M435121-002
22	Screw, 2x1/4 Rd. H. Type Z	J525007
24	Pop Rivet, 1/8 Dia.	J490029
26	Name plate	M451108-5202

* A suffix -0105 unit is a -0103 unit that has been converted to 100 Hz operation.

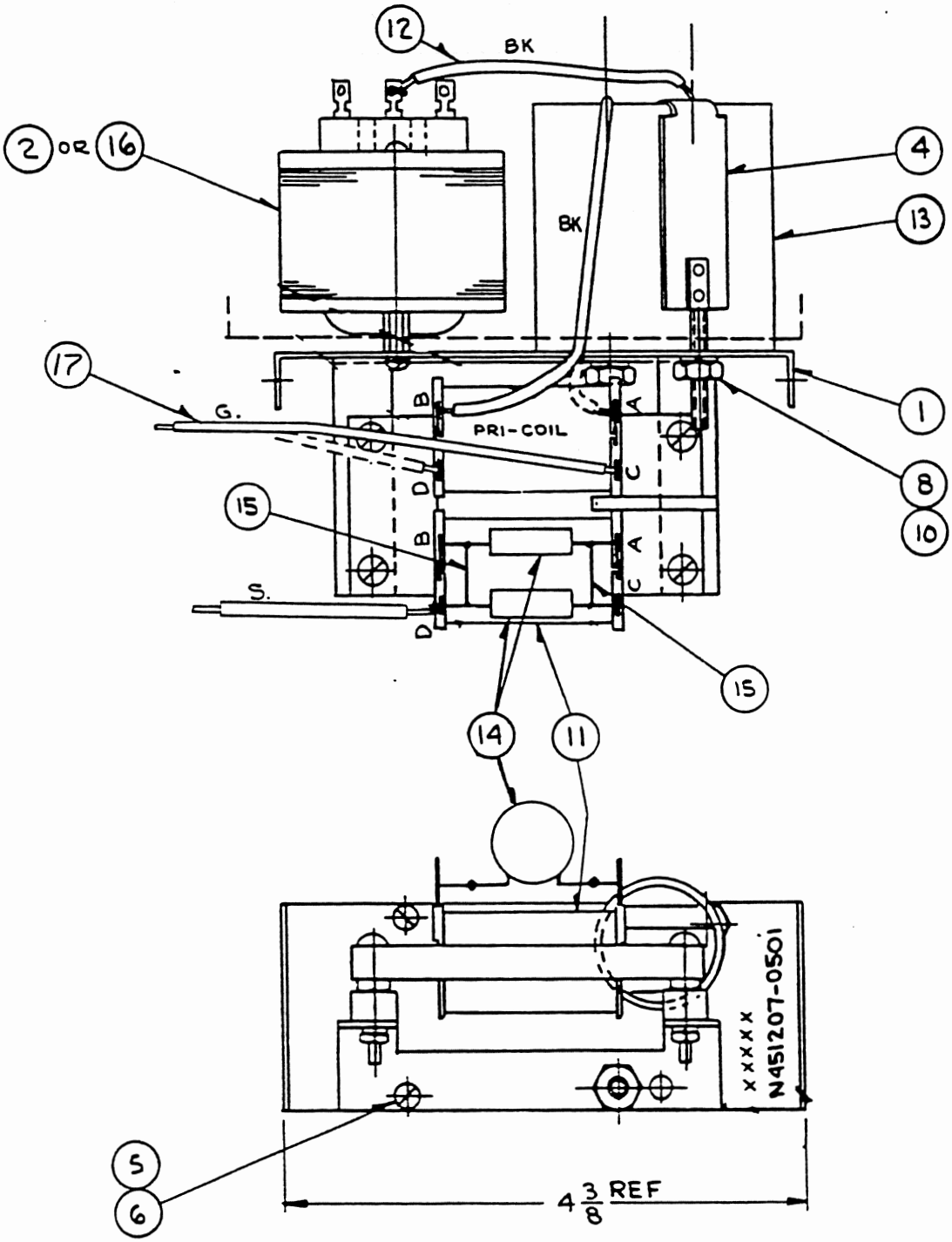


Drawing F451206 Sh. 1, Rev. 6

Figure A-1. TRU-II Plug-In Unit

PARTS LIST FOR TRU-II UNIT 1
Part No's. N451207-0501 and -0502
(See Figure A-2)

ITEM NO.	DESCRIPTION	PART NUMBER
1	Bracket, Assembly	N451207-0204
2	Inductor, 1.25 Henry (Suffix -0501 Only)	N451039-4001
4	Bracket, Capacitor	J792776
5	Screw, 4-40 x 3/8 Rhd. Stl.	J525074
6	Washer, 4 Stl. Lk. Med.	J047765
8	Washer, 10 Stl. Lk. Med.	J047733
10	Nut, 10-32 Hex. Stl.	J048172
11	Transformer (one to eight)	N451039-4101
12	Wire, 20 PVC Black	A045505-0001
13	Capacitor, 2 MFD 660 Vac	J709145-0511
14	Matched Varistors	N451207-1501
15	Wire, 20 TFE Black	A045219-0001
16	Inductor, 1.25 Henry (Suffix -0502 Only)	N451039-4004
17	Wire, 20 PVC GRN	A045505-004

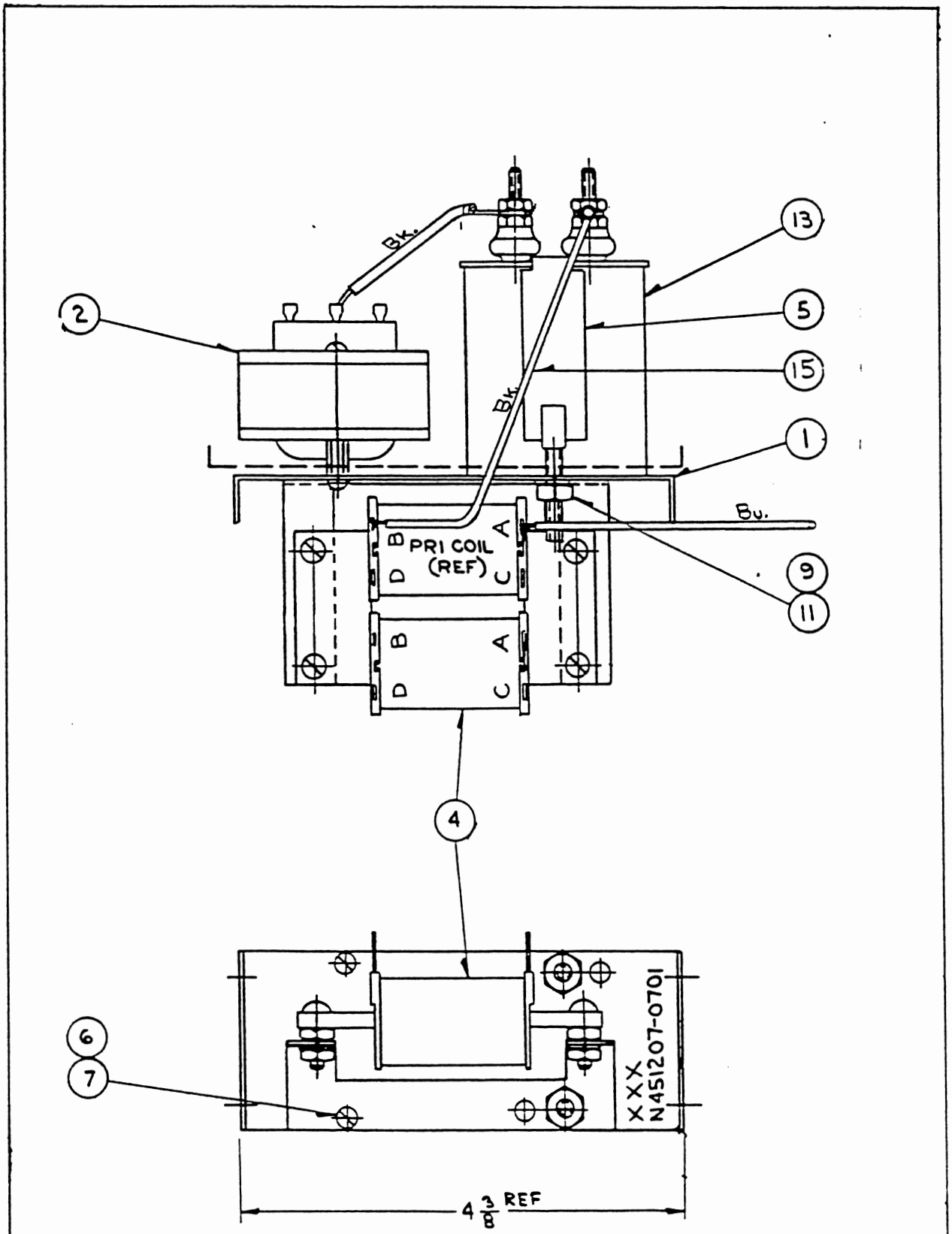


Drawing D451207 Sh. 5, Rev. 8

Figure A-2. TRU-II Unit 1

PARTS LIST FOR TRU-II UNIT 2
Part No's. N451207-0701 and -0702
(See Figure A-3)

ITEM NO.	DESCRIPTION	PART NUMBER
1	Bracket, Assembly	N451207-0204
2	Inductor, 12 Henry (Suffix -0701 Only)	N451039-4003
	Inductor, 12 Henry (Suffix -0702 Only)	N451039-4006
4	XFRMR (one to one)	N451039-4102
5	Bracket, Capacitor	J792776
6	Screw, 4-40 x 3/8 Rhd. Stl.	J525074
7	Washer, 4 Stl. Lk. Med.	J047765
9	Washer, 10 Stl. Lk. Med.	J047733
11	Nut, 10-32 Hex. Stl.	J048172
12	Wire, 20 PVC Black	A045505-0001
13	Capacitor, .2 MFD 2000V	J709145-0383

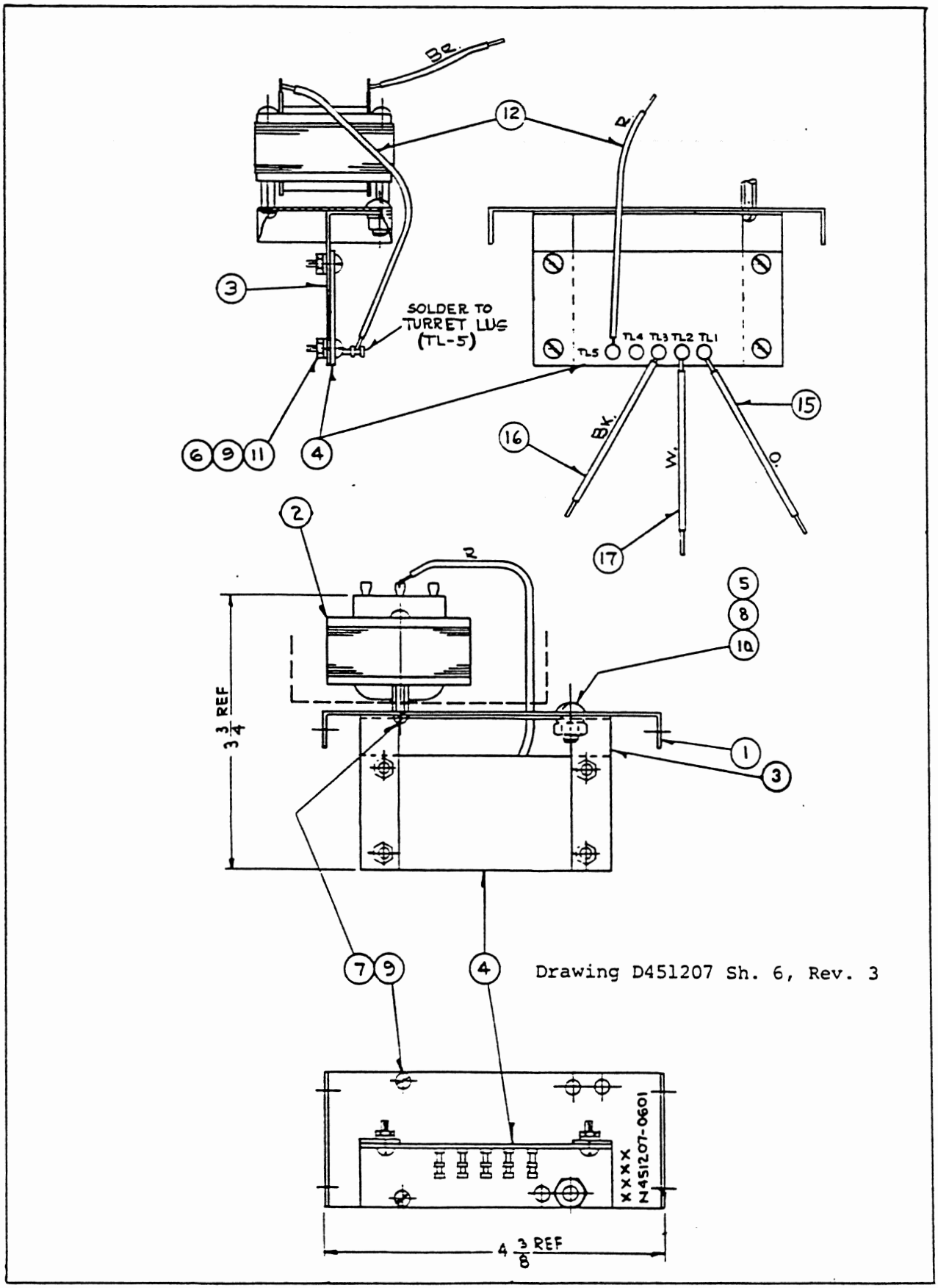


Drawing D451207 Sh. 7, Rev. 4

Figure A-3. TRU-II Unit 2

PARTS LIST FOR TRU-II UNIT 3
Part No's. N451207-0601 and -0602
(See Figure A-4)

ITEM NO.	DESCRIPTION	PART NUMBER
1	Bracket, Assembly	N451207-0204
2	Inductor, 25 Henry (Suffix -0601 Only)	N451039-4002
	Inductor, 25 Henry (Suffix -0602 Only)	N451039-4005
3	Support	M451207-0401
4	PCB, TRU-II	N451522-7801
5	Screw, 10-32 x 3/8 In. Rd.	J052564
6	Screw, 4-40 x 5/16 Rdh. St.	J525057
7	Screw, 4-40 x 3/8 Rhd. Stl.	J525074
8	Nut, 10-32 Hex. Stl.	J048172
9	Washer, 4 Stl. Lk. Med.	J047765
10	Washer, 10 Stl. Lk. Med.	J047733
11	Nut, 4-40 Hex. Steel	J480006
12	Wire, 20 PVC Red M258-30	A045505-0006
15	Wire, 20 PVC Brown	A045505-0005
16	Wire, 20 PVC Black	A045505-0001
17	Wire, 20 PVC White	A045505-0008

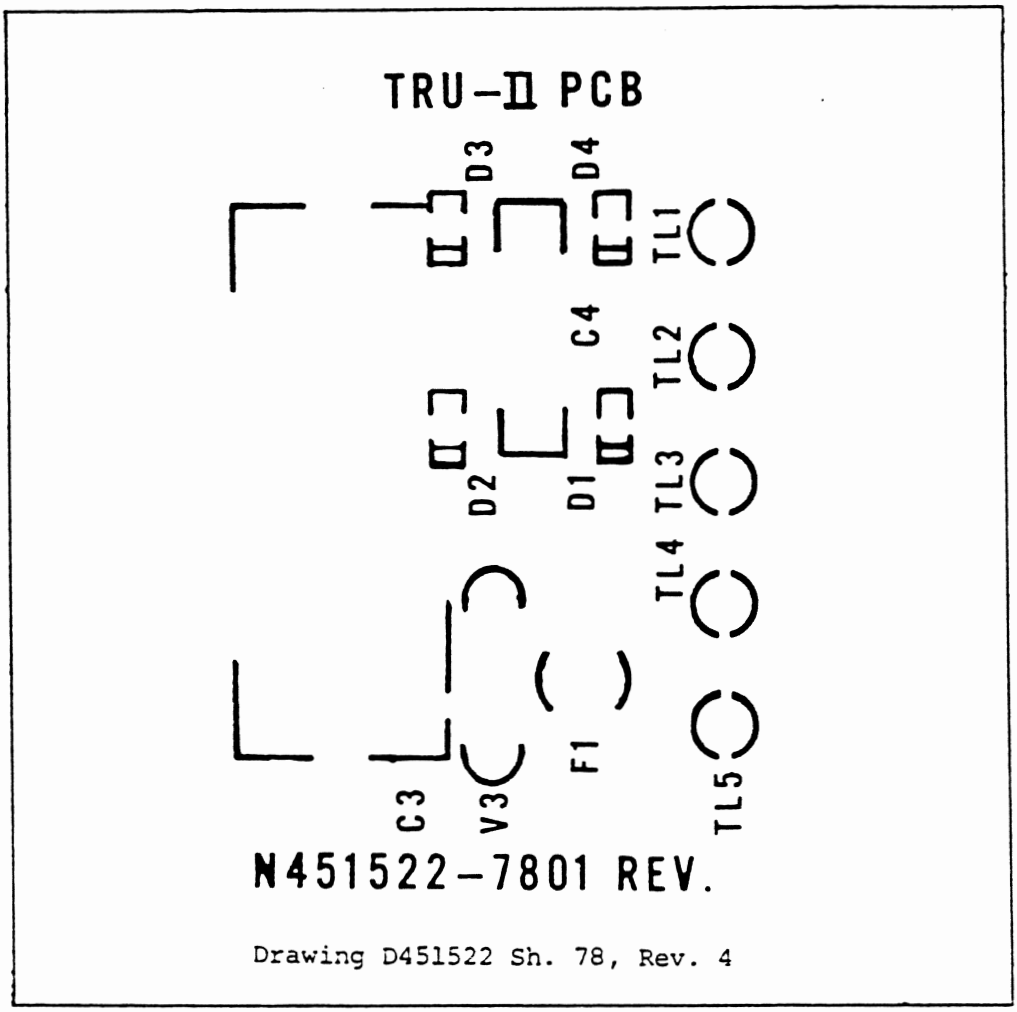


Drawing D451207 Sh. 6, Rev. 3

Figure A-4. TRU-II Unit 3

PARTS LIST FOR TRU-II PCB
(See Figure A-5)

ITEM NO.	DESCRIPTION	PART NUMBER
	Printed Circuit Board (Complete)	N451522-7801
	Epoxy, Sheet 1/16 M-7175	A772101
D1-D4	Diode, 1N4005 600 V	J723568
C3	Capacitor, .1 MFD 1000 V	J709145-0384
V3	Varistor, 22 Vdc V27ZA60	J735548
F1	Micro Fuse 1/64 A.	J710143
TL1-TL5	Turret Lug	J714159
C4	Capacitor, .0047 MFD	J709145-0130



Drawing D451522 Sh. 78, Rev. 4

Figure A-5. TRU-II Printed Circuit Board

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ADDENDUM 1

TRU-II AC TRACK UNIT

N451206-0101
N451206-0102
N451206-0103
N451206-0104
N451206-0105
N451206-0106

This addendum updates SM-6236, which was published in June, 1984. This addendum does not contain any replacement pages for SM-6236, but should be placed at the end of the manual. It is provided to report three additional top part numbers for the TRU-II AC Track Unit:

US&S Part No.	Description
N451206-0102	AC Track Unit N451206-0101 with rack mounting plate N451207-0202
N451206-0104	AC Track Unit N451206-0103 with rack mounting plate N451207-0202
N451206-0106	AC Track Unit N451206-0105 with rack mounting plate N451207-0202

Mounting plate N451207-0202 allows the AC Track Unit to be mounted in a standard equipment rack. This mounting plate is not available with AC Track Units -0101, -0103 and -0105 and must be ordered separately for these units.

The information in this addendum will be incorporated in the next printing of SM-6236.

June, 1992
PC-6085

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